Department for Environment, Food and Rural Affairs

Paper 5: Indicator and Monitoring Framework

November 2012

Contents

Summary and key messages

1. The Committee on Climate Change (CCC) challenged the Government to develop a framework of indicators and supporting data on farm practices within their 3rd and 4th annual progress reports to Parliament[1]. Defra has worked closely with stakeholders, including the CCC, to develop an indicator framework that will provide a leading indication of agriculture's progress in reducing its GHG emissions.

2. The monitoring framework consists of ten key indicators covering farmer attitudes and knowledge, the uptake of mitigation methods and the GHG emission intensity of production in key agricultural sectors. The structure will allow broad, high level assessments to be made whilst still providing the flexibility to carry out detailed analysis of the background data when necessary. Also as and when evidence and data becomes available which might add value to it, the framework can be adapted to incorporate changes to the way we monitor the progress of the sector.

3. Defra will undertake an annual assessment of the indicators until 2016. This monitoring process will contribute towards our ongoing dialogue with the Industry Partnership which leads on the implementation of the Greenhouse Gas Action Plan (GHGAP) Phase 2.

4. In 2016, Defra will formally review agriculture's progress in reducing Greenhouse Gas (GHG) emissions following the completion of research to improve the agricultural inventory and the Industry's GHGAP Phase 2 (2012 – 2015). However, the timing and scale of this review is flexible and may be brought forward based an annual assessment of progress using both long term and short term success criteria:

    - Trends in the indicators moving in the right direction from the previous year and/or over the longer term are a clear measure of success

    - A significant trend in the indicators moving in the wrong direction for two consecutive years or over the longer term would provide cause for concern and prompt further analysis

5. The data required to populate the indicator framework will be obtained from a variety of sources including Defra's Farm Practices Survey and the British Survey of Fertiliser Practice. Updated indicators together with the Government's annual assessment of progress will be published each July within the annual update of 'Agriculture Statistics and Climate Change[2].

[1] Meeting Carbon Budgets – 2012 Progress Report to Parliament: Chapter 6 – Progress reducing emissions from agriculture (http://www.theccc.org.uk/reports/2012-progress-report)

[2] http://www.defra.gov.uk/statistics/foodfarm/enviro/indicatorsghg/

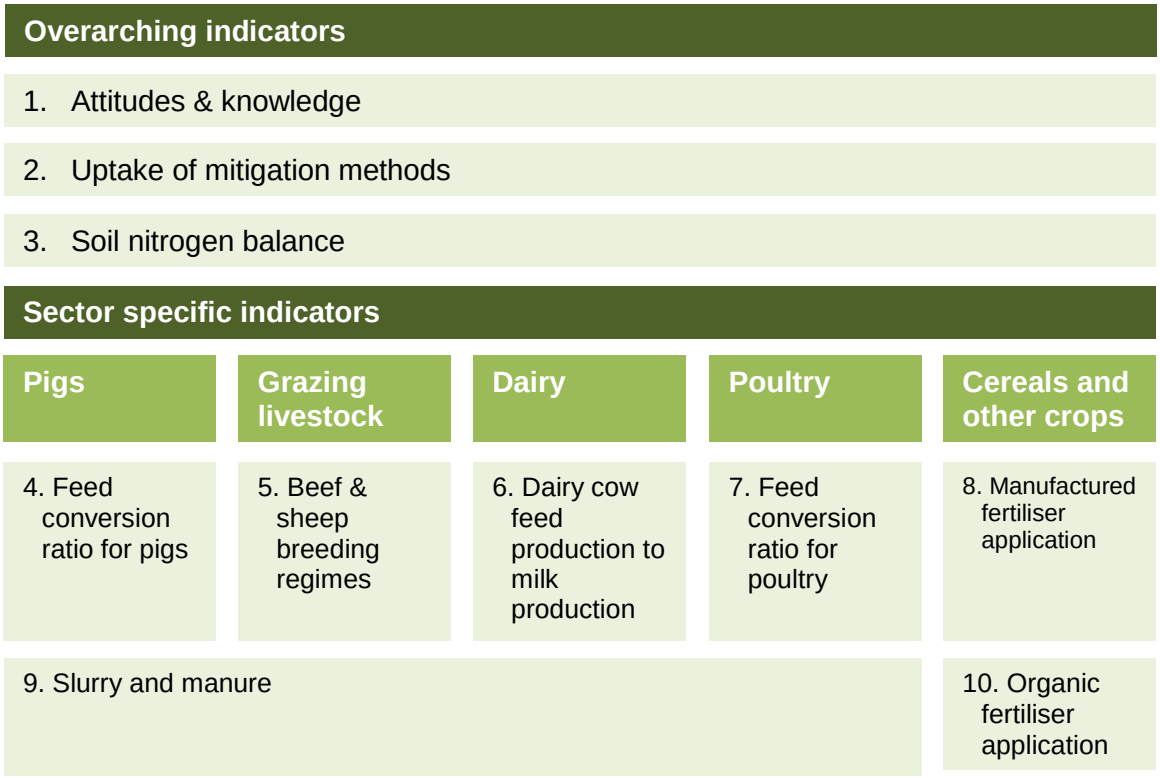
Introduction

6. This paper outlines the indicator framework that has been developed by Defra to provide a leading indication of agriculture's progress in reducing its GHG emissions. It sets out how these indicators will be monitored and our approach for collecting and presenting the information, building on 'Agricultural Statistics and Climate Change' which was first published in 2011 and most recently updated in July this year.

7. The indicator framework has been developed in collaboration with stakeholders including the CCC, who in their 3rd and 4th annual progress reports to Parliament, challenged the Government to develop a framework of indicators and supporting data on farm practice.

Indicator framework

Figure 1: Indicator framework



8. The framework consists of ten key indicators covering farmer attitudes and knowledge, intermediate outcomes relating to GHG emission intensity[3] of production in key agricultural sectors and the uptake of mitigation methods (Figures 1 and 2). As far as possible, the framework reflects the farm practices which are aligned to the Industry's Action Plan and acknowledges the indicators set out in the CCCs annual progress

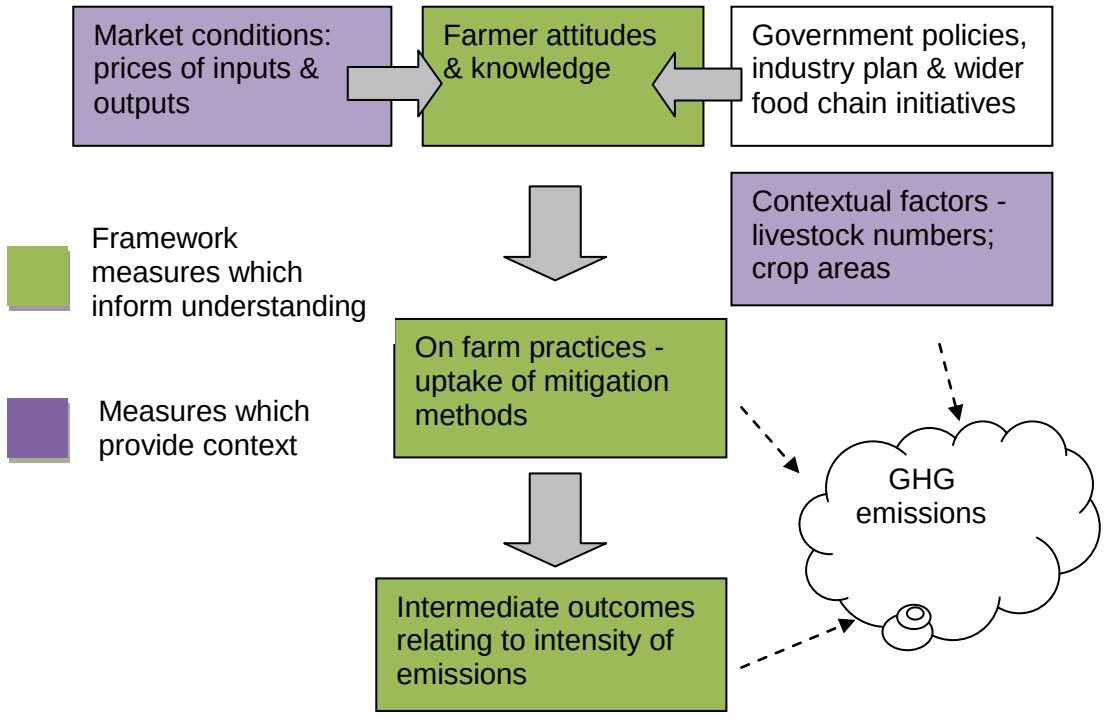
[3] GHG emitted per tonne of crop, litre of milk or kilogramme of meat produced.

reports. The structure will allow broad, high level, assessments to be made whilst still providing the flexibility to carry out detailed analysis of the background data when necessary. Also as and when evidence and data becomes available which might add value to it, the framework can be adapted to incorporate changes to the way we monitor the progress of the sector.

9. Each indicator is supported by technical guidance which includes information on data sources, uncertainty, data limitations and time lags[4]. The data required to populate the indicator framework are obtained from a variety of sources. These include:

   - Farm Practices Survey[5]
   - British Survey of Fertiliser Practice[6]
   - June Agricultural Survey
   - Other Defra surveys and industry data sources

Figure 2: System diagram of leading indicators contained in the monitoring framework



10. The framework does not include a specific indicator of GHG emissions from agriculture. This is because it has been designed to assess progress in reducing GHG emissions whilst research is undertaken to improve the inventory calculations (completion

[4] http://www.defra.gov.uk/statistics/foodfarm/enviro/indicatorsghg/

[5] http://www.defra.gov.uk/statistics/foodfarm/enviro/farmpractice/

[6] http://www.defra.gov.uk/statistics/foodfarm/enviro/fertiliserpractice/

expected in 2015). The current GHG inventory calculations are not sensitive to changes in the uptake of mitigation practices and contain a high level of uncertainty.

Monitoring process

11. Defra will undertake an annual assessment of the indicators until 2016. This monitoring process will also contribute towards our ongoing dialogue with the Industry Partnership leading the implementation of the GHGAP Phase 2 and will assist the assessment of progress towards their Phase 2 goal:

    - '*By 2015, the partnership will have achieved a high level of awareness in all farming and growing sectors with evidence of a clear upward trend towards increased uptake of priority actions*[7]'

12. In 2016 Defra will review agriculture's progress in reducing GHG emissions, following the completion of research to improve the agricultural inventory and the Industry's GHGAP Phase 2 (2012 – 2015). The timing and scale of this review will be flexible and may be brought forward based on an annual assessment of progress for each indicator using the following success criteria:

    - Trends in the indicators moving in the right direction from the previous year and/or over the longer term are a clear measure of success

    - A significant trend in the indicators moving in the wrong direction for two consecutive years or over the longer term would provide cause for concern and prompt further analysis

13. At this stage, Defra does not intend to specify targets or trigger points for further intervention. Our proposed approach to monitor and publish progress on an annual basis and amend or consider alternatives in the light of the most recent evidence and data will provide a good basis for transparency and action if progress is not as expected.

14. Defra acknowledges that there will be a need for care in interpreting survey data and recognises that other factors may influence progress such as unusual weather conditions or responses to other environmental priorities or emergencies. Any assessment of progress will include full consideration of all of the available evidence.

15. The indicator framework will be hosted on the Defra website and each indicator will be updated on an ongoing basis as new data become available throughout the year. Defra will publish an overall, annual assessment of progress within the existing 'Agriculture

[7] Meeting the Challenge: Agriculture Industry Action Plant Deliver of Phase 1 2010-2012 (http://nfuonline.com/ghgap)

Statistics and Climate Change' publication[8] each July. As well as providing the existing contextual information, this publication will examine each of the ten indicators in detail.

Indicator framework summary in 2012

16. For some indicators (such as farmer attitudes) there are limited data currently available to assess long or short term change. Where longer term data are available, a current assessment shows the overall picture to be mixed. Over the last 10 years there are positive trends for the soil nitrogen balance (a high level indicator of environmental pressure) and for the derived manufactured nitrogen use efficiency[9] for wheat, barley oilseed rape and sugar beet. However, for intermediate outcomes relating to GHG emission intensity for the livestock sector there has been either little overall change in the longer term trend (e.g. feed conversion ratios for poultry) or some deterioration (e.g. feed conversion ratios for the pig fattening herd). When assessed over the most recent 2 years, the indicators suggest either little change or positive trends in the case of intermediate outcomes relating to poultry, oilseed rape and sugar beet.

17. The Industry has an ambition to reduce agricultural production emissions by 3 $MtCO_2e$ by the 3rd carbon budget compared to a 2007 baseline. Indicators focusing on the uptake of particular mitigation methods, including those relating to organic fertiliser management and application and use within anaerobic digestion provide a measure of progress towards this goal. Together these indicators suggest that, by early 2012, a 1.2 $MtCO_2e$ reduction in GHG had been achieved, 30% of the estimated maximum technical potential[10]. A key component has been the uptake of practices relating to nutrient management, such as the use of fertiliser recommendation systems.

18. The current status of each of the indicators has been summarised below. Symbols have been used to provide an indication of progress:

Clear improvement	✓	Little or no change	≈
Clear deterioration	✗	Insufficient or no comparable data	…

19. The indicators focused on livestock give an insight into the efficiency of production where this can impact on GHG emissions and are intended to be viewed within the context of animal welfare regulations and legislation. To examine the wider potential implications of GHG mitigation measures, including animal health and welfare, Defra

[8] Available at: http://www.defra.gov.uk/statistics/foodfarm/enviro/climate/

[9] Nitrogen use efficiency is calculated as the quantity of crop produced per unit of applied manufactured nitrogen fertiliser

[10] Maximum technical potential is the amount that could be saved if all mitigation potential was enacted regardless of cost and assuming no prior implementation of measures

has commissioned research project AC0226 - Quantifying, monitoring and minimising wider impacts of GHG mitigation measures[11].

[11] http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&ProjectID=17780&FromSearch=Y&Publisher=1&SearchText=AC0226&SortString=ProjectCode&SortOrder=Asc&Paging=10#Description

Indicator descriptions

Overarching indicators				
1 Attitudes & knowledge **Assessment:** behaviour change can be a long process. Measuring awareness of the sources of emissions and intentions to change practice can provide a leading indicator of uptake of mitigation measures and help to highlight motivations and barriers. However, changing attitudes are not a pre-requisite for the adoption of mitigation methods; Research suggests that business sustainability and financial implications are also important drivers of change. • On livestock farms there was a high level of awareness of livestock as a source of GHG emissions but lower levels of awareness for manure and slurry (either direct from livestock or spread on farm) as sources. Less than half of arable farmers suggested bagged nitrogen as a source. • 10% of farmers reported that it was 'very important' to consider GHGs when making decisions relating to their land, crops and livestock and a further 40% thought it 'fairly important'. However, around half of respondents placed little or no importance on considering GHGs when making decisions. • Surveys undertaken by Farming Futures suggest that overall there has been little change in the proportion of farmers that are taking action to mitigate climate change (55% in 2008; 53% in 2011).				
Current Status	**Long term (last 10 years):**	**…**	**Short term (last 2 years):**	**…**

Overarching indicators					
2 Uptake of mitigation methods **Assessment:** there are a wide range of farm practices that, if implemented, will reduce GHG emissions from agriculture. Monitoring the uptake of these mitigation methods provides an indicator of progress towards achieving the industry's ambition to reduce agricultural production emissions by 3 Mt CO_2 equivalent (e) by 2020 compared to a 2007 baseline. • By February 2012, approximately 1.2Mt CO_2e reduction in GHG emissions had been achieved from the uptake of mitigation methods contained within this indicator. This compares to an estimated maximum technical potential[12] reduction of 3.1Mt CO_2e were all of these methods to be fully implemented on relevant farms. • Mitigation methods related to nutrient management (e.g. fertiliser spreader calibration) collectively provide the greatest potential emissions reduction (1.4 Mt CO_2e). By 2012, uptake of these methods has been assessed to have delivered an estimated GHG reduction of 0.7Mt CO_2e, which is around 48% of the maximum technical potential reduction.					
Current Status	**Long term (last 10 years):**	**…**	**Short term (last 2 years):**	**…**	
3 Soil nitrogen balance **Assessment:** whilst a shortage of nutrients can limit the productivity of agricultural soils, a surplus of these nutrients poses a serious environmental risk. The soil nitrogen balance is a high level indicator of potential environmental pressure providing a measure of the total loading of nitrogen on agricultural soils. The balances do not estimate the actual losses of nutrients to the environment (e.g. to water or to air) but significant nutrient surpluses are directly linked with losses to the environment. • In the long term, the nitrogen surplus in England has fallen by 17% since 2000. The main drivers have been reductions in the application of inorganic fertilisers (particularly to grass) and manure production (due to lower livestock numbers), partially offset by a reduction in the nitrogen offtake (particularly forage). • In the shorter term, provisional figures show that the nitrogen balance reduced by 4% between 2010 and 2011. This was driven by increased offtake via harvested crops, and reduced inputs from nitrogen fixation (due to reduced planted areas of pulses) and manure production (from reduced cattle populations). These offset a small increase in inputs from inorganic nitrogen fertilisers.					
Current Status	**Long term (last 10 years):**	**✓**	**Short term (last 2 years):**	**≈**	

[12] Maximum technical potential is the amount that could be saved if all mitigation potential was enacted regardless of cost assuming no prior implementation of measures

Sector specific indicators					
4 Pig sector: feed conversion ratio for fattening herd **Assessment:** the feed conversion ratio (FCR) is a measure of the amount of feed required to increase pig live weight by 1kg. It is used here as a proxy measure for on-farm greenhouse gas emissions intensity[13] (see **Livestock indicators** note at the beginning of summary). • Following improvements during the early 1990s, the FCR for the pig fattening herd has deteriorated (i.e. more feed required per unit increase in pig weight), albeit with some fluctuations in recent years. • This would imply a reduction in feed efficiency and increased emissions intensity. However, achieving and maintaining heavier weights, relative changes in production systems and disease could be explanatory factors.					
Current Status	**Long term (last 10 years):**	✗	**Short term (last 2 years):**	≈	
5 Grazing livestock sector: beef and sheep breeding regimes **Assessment:** the selection of useful traits can help improve herd and flock productivity and efficiency which can in turn influence GHG intensity. The Estimated Breeding Value (EBV) is an estimate of the genetic merit an animal possesses for a measured trait or characteristic. The EBV is used here as a proxy measure for on-farm GHG emissions intensity (see **Livestock indicators** note at the beginning of summary). • Overall in 2012, bulls and rams with a high EBV were used at least 'most of the time' on 39% of farms breeding beef cattle and 29% of those breeding lambs. There was no significant change between 2011 and 2012. • Whilst there is little difference between lowland farms and those in Less Favoured Areas there are differences between farm sizes, with uptake greatest on larger farms.					
Current Status	**Long term (last 10 years):**	…	**Short term (last 2 years):**	≈	

[13] GHG emitted per tonne of crop, litre of milk or kilogramme of meat produced.

Sector specific indicators					
6 Dairy sector: ratio of dairy cow feed production to milk production **Assessment:** considering milk yields in conjunction with trends in inputs (such as feeds) provides an indication of GHG intensity[14] in the dairy sector. The ratio of dairy cow compound and blended feed production to milk production is used here as a proxy measure for on-farm GHG emissions intensity (see **Livestock indicators** note at the beginning of summary). It is recognised that this indicator is not ideal. Firstly, it considers production of feed rather than overall dry matter consumption but, perhaps more importantly, it does not attempt to assess the consumption of concentrates produced by on-farm mixing, or of grazed or conserved forage. We will continue to investigate other data sources such as survey data and farm benchmarking data to improve this indicator. • The ratio is currently at levels similar to the early 1990s. There have been some fluctuations over the period. However, the indicator has increased since 2005 as the rate of increase of compound and blended feed production has been greater than the rate of increase in average milk yields. In the shorter term, the ratio has remained little changed. • There has been an upward trend in both the average milk yield and in the production of compound feed per cow over the period.					
Current Status	**Long term (last 10 years):**	✗	**Short term (last 2 years):**	≈	
7 Poultry sector: feed conversion ratio for table birds **Assessment:** more efficient use of feed has the potential to increase productivity and reduce GHG intensity[14]. The feed conversion ratio (FCR) is a measure of the amount of feed required (kg) to produce 1kg of poultrymeat (dressed carcase weight). The indicator provides an overall measure of feed efficiency. Within this there are differences between production systems and species. It is used here as a proxy measure for on-farm GHG emissions intensity (see **Livestock indicators** note at the beginning of summary). • There was a slight upward trend in the overall FCR for table birds between 2001 and 2008, suggesting a possible increase in emissions intensity. • There has been some recent improvement in the FCR, although the change is well within the year on year variation. The improvement has been greater and for a longer period for turkeys than for broilers. It is too early to say if the recent improvement will be sustained.					
Current Status	**Long term (last 10 years):**	≈	**Short term (last 2 years):**	✓	

[14] GHG emitted per tonne of crop, litre of milk or kilogramme of meat produced.

Sector specific indicators

8 Cereals and other crops: manufactured fertiliser application

Assessment: more efficient use of nitrogen fertilisers has the potential to increase productivity and reduce risks to the environment. The ratio of the weight of crops produced to the weight of manufactured nitrogen fertiliser applied provides a proxy measure for the intensity of GHG emissions.

- There has been an increase in the quantity of wheat produced per unit of manufactured nitrogen in the last 20 years, although much of this increase occurred in the 1990s when yields increased whilst fertiliser application rates remained stable. Since 2000, there has been little overall change in apparent nitrogen use efficiency of wheat; average yields have remained stable over the period, and changes in the intensity measure have been due to fluctuations in fertiliser application rates.
- For winter barley, spring barley, winter oilseed rape and sugar beet there has been an overall upward trend in production per unit of applied manufactured nitrogen fertiliser over the last 10 years.

Current Status	**Long term (last 10 years):**	**Short term (last 2 years):**
Wheat	≈	≈
Winter barley	✓	×
Spring barley	✓	≈
Winter oilseed rape	✓	✓
Sugar beet	✓	✓

Sector specific indicators	
9 Slurry and manure **Assessment:** systems for the management of manure and slurry are relevant to the control of environmental risks to air and water, including GHG emissions. Monitoring uptake of relevant mitigation methods provides an indicator of progress towards achieving the industry's ambition to reduce agricultural production emissions by 3 $MtCO_2e$ by 2020 compared to a 2007 baseline. • Estimates indicate that the maximum technical potential[15] GHG reduction from uptake of mitigation methods relating to slurry and manure (which include types of storage and use of liquid/solid manure separation techniques, but exclude anaerobic digestion (AD) systems) is around 0.018 Mt CO_2e. • Uptake of these mitigation methods by February 2012 suggests that the GHG reduction achieved has been around 0.003 Mt CO_2e. • The use of slurries for anaerobic digestion has a significant GHG reduction potential, far outweighing that from improved storage of slurries and manures. However, there are significant start-up and running costs leading to very low levels of current uptake. In 2012, survey data indicated that less than 1% of all farms (rising to 4% of specialist pig and poultry farms) processed slurries for AD, little changed from 2008.	
Current Status	**Long term (last 10 years): … Short term (last 2 years): …**
10 Organic fertiliser application **Assessment:** the form, method and timing of application for organic fertilisers can influence GHG emissions. Monitoring these factors provides an indicator of progress towards achieving the industry's ambition to reduce agricultural production emissions by 3 $MtCO_2e$ by 2020 compared to a 2007 baseline. • By February 2012, approximately 0.040 Mt CO_2e reduction in GHG emissions had been achieved from the uptake of the mitigation methods (which include the timing of applications and application methods) within this indicator. This compares to an estimated maximum technical potential reduction of 0.327 Mt CO_2e were all of these methods to be fully implemented on relevant farms.	
Current Status	**Long term (last 10 years): … Short term (last 2 years): …**

[15] Maximum technical potential is the amount that could be saved if all mitigation potential was enacted regardless of cost assuming no prior implementation of measures.

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